Chapter 1 · Exploration — Entering the World of Secondary Science

PLAY & LEARN

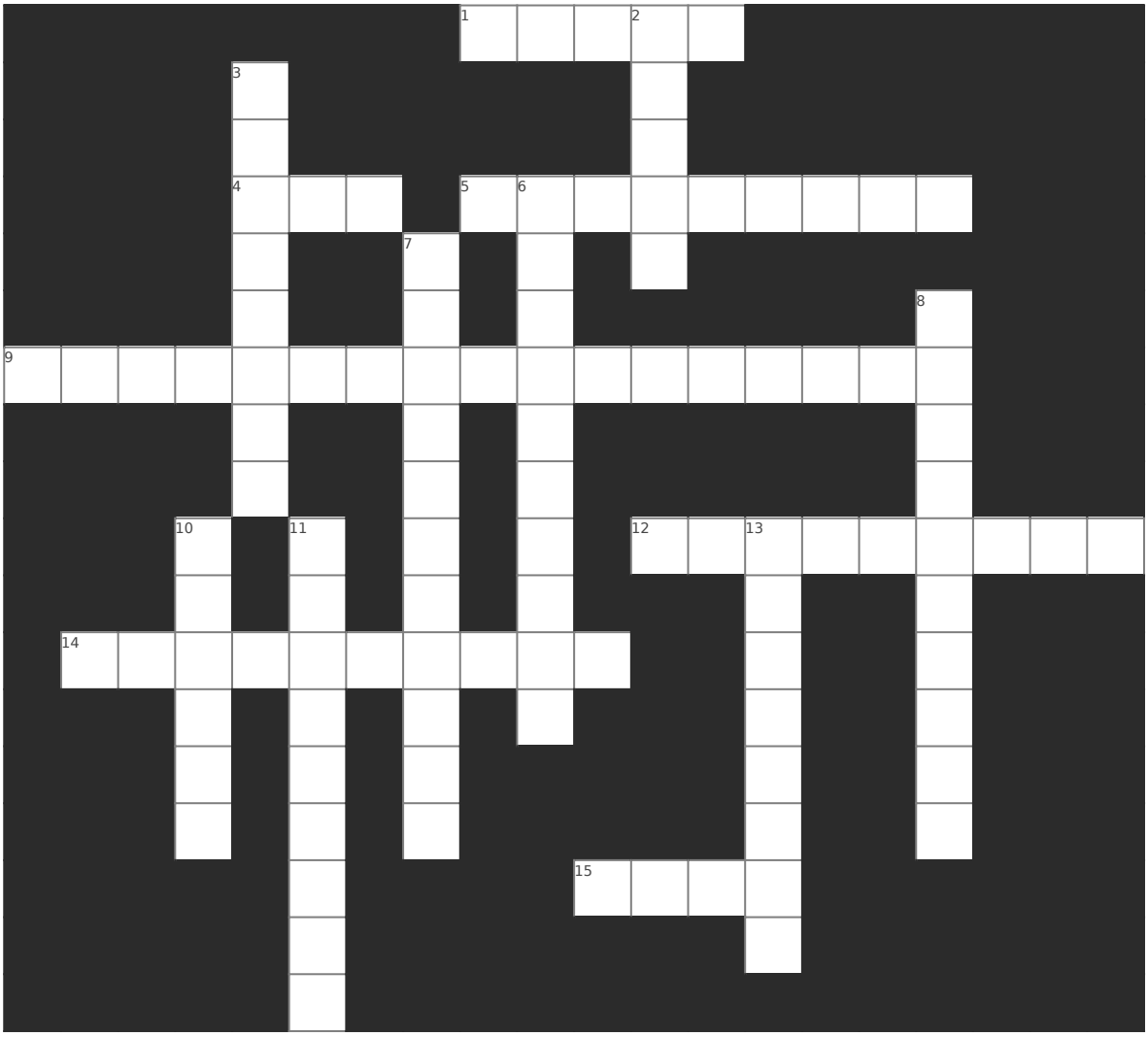
A puzzle workbook — crosswords, word searches, scrambles and quiz games

Print it. Solve it. Race a friend. Answer keys are at the back — no peeking.

#	Puzzle	Play it	Time
1	The Crossword	Solo or pairs	15 min
2	Word Search	Solo — race the clock	10 min
3	Scrambled Terms	Solo	8 min
4	Odd One Out	Teams of 4	10 min
5	Chapter Scrabble	Groups of 3–4	20 min
6	Who Am I? — Clue Cards	Whole class	15 min
7	True or False Sprint	Whole class, standing	6 min
8	Bingo	Whole class	15 min
9	Two Truths and a Lie	Pairs	10 min
10	The Escape Challenge	Teams of 4	25 min

Puzzle 1 · The Crossword

Every answer is a word from this chapter. Fill the white squares — one letter per square.



ACROSS

1. surname of the physicist behind quick order-of-magnitude estimates (5)

4. a reliably repeated pattern, often mathematical (3)

5. Latin word behind the symbol c (9)

9. requiring several branches of science together (17)

12. order of _____ estimate — a rough scale calculation (9)

14. what a good model lets you make (10)

15. Indian astrophysicist who modelled stars with an ionisation equation (4)

DOWN

2. a simplified representation of reality (5)

3. SI base unit of mass (8)

6. making a reasoned guess using order of magnitude (10)

7. a measured, recorded fact (11)

8. a testable proposed explanation (10)

10. a well-tested scientific explanation, not a guess (6)

11. a broad guiding idea, e.g. conservation of energy (9)

13. Latin word behind the symbol g (8)

Puzzle 2 · Word Search

16 terms are hiding in the grid — across, down, diagonally, and backwards. Circle each one, then tick it off the list. Beat 10 minutes and you win.

B	E	I	M	R	E	F	S	T	A	N	D	A	R	D
O	W	P	P	T	O	X	O	T	F	L	N	K	R	Q
U	O	M	G	R	D	E	T	A	M	I	T	S	E	N
U	N	S	E	B	E	F	U	U	M	O	D	E	L	N
G	R	I	S	N	Z	D	E	N	S	I	T	Y	O	L
R	E	S	T	M	B	T	I	B	F	E	J	I	H	H
B	T	E	K	S	S	F	D	C	D	U	T	S	O	L
F	T	H	I	J	B	M	T	U	T	A	Y	N	O	C
L	A	T	L	Y	G	P	T	F	V	I	F	M	K	Z
Y	P	O	O	O	Y	I	K	R	B	F	O	F	E	S
W	N	P	G	E	N	Q	E	U	W	M	D	N	M	D
H	D	Y	R	G	N	S	X	U	J	X	J	R	U	D
L	Q	H	A	T	B	P	T	Y	R	O	E	H	T	H
R	J	M	M	O	E	C	N	E	I	C	S	A	V	F
V	M	A	H	A	S	W	H	D	Q	U	Y	P	D	S

☐ OBSERVATION	☐ HYPOTHESIS	☐ PREDICTION
☐ MAGNITUDE	☐ ESTIMATE	☐ KILOGRAM
☐ STANDARD	☐ DENSITY	☐ PATTERN
☐ SCIENCE	☐ THEORY	☐ MODEL
☐ FERMI	☐ HOOKE	☐ UNITS
☐ SAHA		

Race Rules

- **Solo:** find all the words. Note your time at the top of the page.
- **Pairs:** one partner finds across-and-down words, the other finds diagonals. First pair to complete the list wins.
- **Hard mode:** cover the word list. Find as many chapter terms as you can in 5 minutes.
- **Champion move:** for every word you find, say what it means out loud. No meaning, no point.

Puzzle 3 · Scrambled Terms

Every row is a chapter word with its letters shuffled. Unscramble it. The clue in brackets is your lifeline — try to solve without it first.

#	Scrambled letters	Clue	Your answer
1	S N L O F A I C P I I T I M	(stripping a problem to only what matters)	_____
2	A N N S I T O O I I	(losing or gaining electrons; central to the Saha equation)	_____
3	T L R N E O S O I U	(the clarity or fineness of a measurement)	_____
4	E M I A U G N D T	(order of _____ — how big, roughly)	_____
5	I L T I B T C R Y A I P D E	(how well a model can forecast the future)	_____
6	I S D A N T S D D E R A	(agreed the same way everywhere, like SI units)	_____
7	I I I S L N T P D Y A I N E R C R	(crossing several branches of science at once)	_____
8	A O A N I N X T E L P	(what a scientific theory ultimately gives you)	_____

Make It a Game

Beat the Bell: the teacher sets a 60-second timer. Every unscrambled word inside the bell = 1 point; a word you can also *define* = 3 points.

Chain Scramble: in a circle, each student scrambles a chapter word for the person on their left. Miss it and you are out. Last student standing wins.

Puzzle 4 · Odd One Out

Three belong together. One does not. Circle the odd one — then write why in one line. The "why" is where the marks are.

#	Which is the odd one out?	Because…
1	Model · Theory · Law · Opinion	_____
2	Kilogram · Metre · Second · Inch	_____
3	Meghnad Saha · Enrico Fermi · Robert Hooke · Isaac Newton (this chapter)	_____
4	Observation · Pattern · Law · Guess	_____
5	Physics · Chemistry · Biology · A single subject solving COVID-19	_____
6	Weather app · Google Maps · A photograph · A simplified model	_____

Puzzle 5 · Chapter Scrabble

Play in groups of 3–4. You have one shared rack of letter tiles. Build only terms from this chapter — no ordinary English words allowed.

Your tile rack — cut these out or write them on paper squares:

A 1	**B** 3	**C** 3	**D** 2	**E** 1	**G** 2	**H** 4
I 1	**L** 1	**M** 3	**N** 1	**O** 1	**P** 3	**R** 1
S 1	**T** 1	**U** 1	**V** 4	**X** 8	**Y** 4	**Z** 10

Scoring:

You did this	Points
Each letter tile used	Its tile value
Word is a term from this chapter	× 2
Word is 8 letters or longer	+ 10 bonus
You can state its meaning correctly	+ 5
You can connect it to a real-life example	+ 3
Word is *not* in this chapter (challenged and lost)	− 5

How a Round Works

1. Player builds a word from the rack and lays it down.
2. Any opponent may **challenge** within 10 seconds: "That's not in this chapter."
3. Open the textbook. If the challenger is right, the word is removed and the builder loses 5 points. If the challenger is wrong, the *challenger* loses 5 points.
4. Builder states the meaning to claim the +5 bonus. The group votes on whether it was correct.
5. Play 6 rounds. Highest total wins.

Target Words (worth the most — do not show your opponents)

MAGNITUDE · HYPOTHESIS · INTERDISCIPLINARY · ESTIMATION · OBSERVATION · PREDICTION · IONISATION · STANDARDISED

Puzzle 6 · Who Am I? — Clue Cards

Cut along the lines. One student draws a card and reads only the first clue aloud; the class guesses. Wrong guess? Read clue 2. Fewer clues used = more points.

CARD 1 ① I am a simplified snapshot of reality. ② A weather app and Google Maps both use me. ③ I am a model.	**CARD 2** ① I ignore billions of details on purpose. ② Good scientists know exactly which ones I drop. ③ I am simplification.
CARD 3 ① I studied starlight using just three quantities. ② My equation explains why stars glow different colours. ③ I am Meghnad Saha.	**CARD 4** ① I estimate without needing exact data. ② I was named after a physicist who guessed piano tuners in Chicago. ③ I am a Fermi estimate.
CARD 5 ① In everyday speech I mean a guess. ② In science I mean a extraordinarily well-tested explanation. ③ I am a theory.	**CARD 6** ① I am a reliably repeated, often mathematical, pattern. ② Newton's Law of Cooling is an example of me. ③ I am a law.
CARD 7 ① I caused a plane to nearly run out of fuel in 1983. ② The mix-up was kg vs pounds per litre. ③ I am a unit conversion error.	**CARD 8** ① I am exactly 299,792,458 m/s. ② My symbol comes from the Latin for speed. ③ I am the speed of light.
CARD 9 ① I am no longer a metal cylinder in France. ② I am now defined using Planck's constant. ③ I am the kilogram.	**CARD 10** ① I needed physics, chemistry, biology, maths and social science together. ② No single chapter could solve me. ③ I am COVID-19 transmission.
CARD 11 ① I have three layers and stop droplets, not individual viruses. ② My middle layer uses electrostatic forces. ③ I am a face mask.	**CARD 12** ① I am the courage to ignore most of reality, wisely. ② This is one of science's greatest powers. ③ I am productive simplification.

Scoring: guessed after clue ① = **5 points** · after ② = **3 points** · after ③ = **1 point**

Puzzle 7 · True or False Sprint

Everyone stands. Teacher reads a statement. True → stay standing. False → sit down. Get it wrong and you are out. Last student standing wins.

#	Statement	Your call
1	A model must be perfect to be useful.	☐ True ☐ False
2	The SI system prevents dangerous unit-conversion errors.	☐ True ☐ False
3	A scientific theory is just an unproven guess.	☐ True ☐ False
4	Meghnad Saha studied stars using temperature, pressure and ionisation.	☐ True ☐ False
5	Fermi estimation aims for an exact answer, not a range.	☐ True ☐ False
6	Air Canada Flight 143 ran out of fuel due to a unit-conversion mistake.	☐ True ☐ False
7	COVID-19 could have been solved using biology alone.	☐ True ☐ False
8	The kilogram is now defined using a physical object kept in France.	☐ True ☐ False
9	A model's job is to be useful, not perfect.	☐ True ☐ False
10	Weather forecasts beyond 7-10 days remain unreliable due to chaos.	☐ True ☐ False
11	The word "cell" in biology and "cell" in a prison share the same origin idea.	☐ True ☐ False
12	Order-of-magnitude estimates are worthless in science.	☐ True ☐ False
13	A pressure cooker involves physics, chemistry, biology and engineering.	☐ True ☐ False
14	The speed of light symbol c comes from a Hindi word.	☐ True ☐ False

Puzzle 8 · Bingo

Each student fills the empty grid below with any 16 words from the word bank — in any order, one per box. The teacher then reads out meanings, not names. Cross a box only when its meaning is called. First to a full row, column or diagonal shouts BINGO.

Word bank — choose any 16:

Model	Theory	Law	Hypothesis
Observation	Estimation	Fermi	Saha
Kilogram	SI Units	Prediction	Magnitude
Simplification	Interdisciplinary	Resolution	Standardised
Density	Pattern	Chaos	Ionisation

Your bingo card:

Caller’s List (teacher only — read the meaning, never the name)

① "I am a simplified representation of reality." ② "In science, I am the highest, best-tested form of explanation." ③ "I am a reliably repeated, often mathematical, pattern." ④ "I am a testable proposed explanation, not yet proven." ⑤ "I am a measured, recorded fact." ⑥ "I give a reasonable range, not an exact number." ⑦ "I am named after a physicist who guessed piano tuners." ⑧ "I modelled stars using temperature, pressure and ionisation." ⑨ "I am the SI base unit of mass." ⑩ "I ensure a kilogram means the same thing everywhere on Earth." □ "I am what a good model lets scientists make." □ "I describe roughly how big something is, in powers of ten." □ "I mean stripping away all but the essential details." □ "I mean needing more than one branch of science at once." □ "I describe how finely a measurement can distinguish two points." □ "I mean agreed to be the same everywhere."

Puzzle 9 · Two Truths and a Lie

Each set has three statements. Two are true, one is a lie. Circle the lie — and correct it in one line.

Set 1

(a) A model's goal is to be perfect.
(b) A model's goal is to be useful.
(c) All models make assumptions.

The lie is _____ . Corrected: _____

Set 2

(a) Meghnad Saha used three quantities to explain stellar colour.
(b) Saha ignored every atomic collision inside a star.
(c) Saha's equation only works for blue stars.

The lie is _____ . Corrected: _____

Set 3

(a) SI units prevent dangerous conversion errors.
(b) Air Canada Flight 143 crashed due to a unit error.
(c) The 1983 Gimli Glider landed safely with no fatalities.

The lie is _____ . Corrected: _____

Set 4

(a) Fermi estimation seeks an exact number.
(b) Fermi estimation seeks a reasonable range.
(c) Being within a factor of 10 counts as excellent estimation.

The lie is _____ . Corrected: _____

Set 5

(a) COVID-19 needed only virology to understand.
(b) COVID-19 needed physics, chemistry, biology, maths and social science.
(c) Epidemiological models use R0 values.

The lie is _____ . Corrected: _____

Puzzle 10 · The Escape Challenge

Solve all five gates. Each gives you one digit. Collect all five to unlock the exit code.

🔒 GATE 1 — The Model Gate

A raindrop free-falls from 2 km with no air resistance. Using $s = \frac{1}{2}gt^2$, it takes about 20 seconds. Take the first digit of 20.

Digit: ☐

🔒 GATE 2 — The Estimation Gate

Breathing rate at rest is taken as 15 breaths/minute in the worked example. Take the first digit of 15.

Digit: ☐

🔒 GATE 3 — The Unit Gate

Air Canada Flight 143 needed 22,300 kg of fuel. Take the first digit of that number.

Digit: ☐

🔒 GATE 4 — The Symbol Gate

The speed of light is 299,792,458 m/s. Take the first digit.

Digit: ☐

🔒 GATE 5 — The Theory Gate

The Cell Theory (met properly in Chapter 2) rests on how many core points? Use that number.

Digit: ☐

EXIT CODE: ☐ ☐ ☐ ☐ ☐

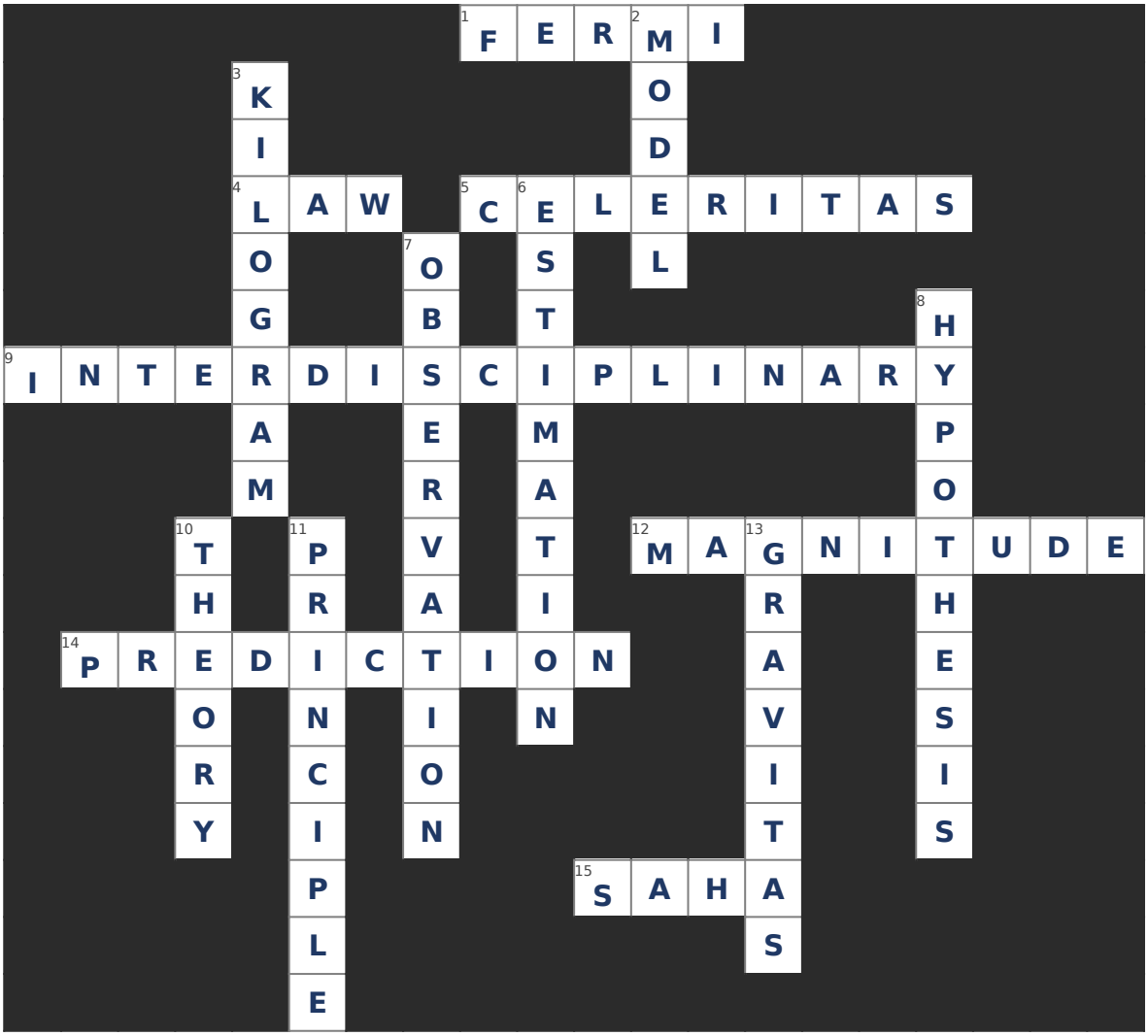
🔒 Teacher's note

Hide the gate cards around the classroom. Teams rotate every 4 minutes. First team to reach the door with the correct code escapes. Losing teams try again next period.

Answer Keys

Teachers and self-checkers only. Solve first — the puzzle is the point.

Puzzle 1 · Crossword — Solved Grid



Across: 1 FERMI · 4 LAW · 5 CELERITAS · 9 INTERDISCIPLINARY · 12 MAGNITUDE · 14 PREDICTION · 15 SAHA

Down: 2 MODEL · 3 KILOGRAM · 6 ESTIMATION · 7 OBSERVATION · 8 HYPOTHESIS · 10 THEORY · 11 PRINCIPLE · 13 GRAVITAS

Puzzle 2 · Word Search — Solved Grid

B	E	I	M	R	E	F	S	T	A	N	D	A	R	D
O	W	P	P	T	O	X	O	T	F	L	N	K	R	Q
U	O	M	G	R	D	E	T	A	M	I	T	S	E	N
U	N	S	E	B	E	F	U	U	M	O	D	E	L	N
G	R	I	S	N	Z	D	E	N	S	I	T	Y	O	L

R	**E**	**S**	**T**	M	B	T	**I**	B	F	**E**	J	**I**	**H**	H
B	**T**	**E**	**K**	**S**	S	F	D	**C**	**D**	U	**T**	S	**O**	L
F	**T**	**H**	**I**	J	B	M	T	**U**	**T**	**A**	Y	N	**O**	C
L	**A**	**T**	**L**	Y	G	P	**T**	F	**V**	**I**	F	M	**K**	Z
Y	**P**	**O**	**O**	O	Y	**I**	K	**R**	B	F	**O**	F	**E**	S
W	N	**P**	**G**	E	**N**	Q	**E**	U	W	M	D	**N**	M	D
H	D	**Y**	**R**	**G**	N	**S**	X	U	J	X	J	R	U	D
L	Q	**H**	**A**	T	**B**	P	T	**Y**	**R**	**O**	**E**	**H**	**T**	H
R	J	**M**	**M**	**O**	**E**	**C**	**N**	**E**	**I**	**C**	**S**	A	V	F
V	M	**A**	**H**	**A**	**S**	W	H	D	Q	U	Y	P	D	S

Puzzle 3 · Scrambled Terms

1. SIMPLIFICATION · 2. IONISATION · 3. RESOLUTION · 4. MAGNITUDE · 5. PREDICTABILITY · 6. STANDARDISED · 7. INTERDISCIPLINARY · 8. EXPLANATION

Puzzle 4 · Odd One Out

#	Odd one	Because
1	Opinion	the other three are structured, testable scientific concepts
2	Inch	the only non-SI unit; the rest are SI base units
3	Robert Hooke	the only one not directly linked to estimation/models in this chapter (he is a Ch.2 figure)
4	Guess	the other three are the ladder observation→pattern→law, all evidence-based
5	A single subject	COVID-19 needed physics+chemistry+biology+maths+social science together
6	A photograph	the other three are all simplified models, not literal copies of reality

Puzzle 7 · True or False Sprint

1-F · 2-T · 3-F · 4-T · 5-F · 6-T · 7-F · 8-F · 9-T · 10-T · 11-T · 12-F · 13-T · 14-F

Puzzle 9 · Two Truths and a Lie

Set	The lie	Correction
1	a	A model's goal is to be useful, not perfect — all models simplify.
2	c	The Saha equation explains the colour spectrum of all stars, not just blue ones.
3	b	It did not crash — it glided to a safe emergency landing.
4	a	Fermi estimation deliberately seeks a range, not an exact figure.
5	a	COVID-19 required many branches of science working together, not virology alone.

Puzzle 10 · The Escape Challenge

EXIT CODE: 2 · 1 · 2 · 2 · 3

(Answer: 2) (Answer: 1) (Answer: 2) (Answer: 2) (Answer: 3)

Now go build your own Fermi estimate — and see how close you can get. □□